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# ON THE RELEVANCY OF IMAGERY TO THE PROCESSES OF THOUGHT<sup>1</sup>

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	PAGE
I. Introduction.....	196
II. Experiment A.....	197
1. Problems.....	197
2. Repetition of Fox's Experiment.....	206
III. Experiment B.....	211
1. Likenesses and Differences.....	211
2. Experiment Under Non-Laboratory Conditions.....	216
IV. Experiment C.....	216
1. Sorting Problems.....	217
2. Reading Problem Containing Irrelevant Meanings.....	218
3. Reading Problem Containing Typographical Errors.....	219
V. Experiment D.....	219
1. Pictures.....	219
2. Completion-Tests.....	222
3. Three-word Imagery.....	223
VI. Conclusion.....	229

In an article in the *Zeitschrift für Psychologie*<sup>2</sup> Dr. Koffka of Giessen says in criticism of an analysis of "Conscious Attitudes":<sup>3</sup> "It is obvious that analysis meant for the author and her observers nothing else than the exhibition of the sensory contents present at any given moment. . . . These sensory contents may [however] be irrelevant to the thought, or may be the necessary condition of the arousal of the thought, or may finally be the thought itself." Clearly the value of the analysis of a thought-process is dependent upon the relevancy of the contents which constitute that analysis to the thought-process analyzed. To find a criterion of relevancy and irrelevancy we undertook the following series of experiments. More particularly, we hoped to secure a basis for answering such a question as that asked by Koffka: How do we know that any sensory content is relevant or irrelevant to a thought? We have concerned ourselves especially with the relation of imaginal contents to thought, since it seemed wise to limit the problem. The *O's* have, however,

<sup>1</sup> From the Psychological Laboratory of Cornell University.

<sup>2</sup> 63, 1912, 219.

<sup>3</sup> H. M. Clarke, *Conscious Attitudes*, *Am. Jour. Psych.*, 22, 1911, 214-219.

frequently mentioned in their reports the parts played by sensory kinaesthesia and by feeling.

Relevancy may be of two kinds, material and logical. It is possible for imaginal contents to be materially relevant but logically irrelevant to a thought. For example, in reply to a question concerning the number of small boxes contained within larger ones, an *O* gave the correct answer, 21. When asked to report the imagery upon which this answer was based, he described a complex visual image of white boxes about six inches square with a grey interior. Logically, the grey and the white and the dimensions have nothing to do with the solution of the problem. The boxes might just as well have been red, or have had no color ascribed to them. Materially, however, the imagery was relevant, since for this particular *O* the meaning 'box' was carried by the particular kind of box described.<sup>4</sup>

We started out with the belief that we might find in the analysis of thought-processes a good deal of irrelevant material. We expected to have reported contents irrelevant to the thought concerned. Our task was then to be a determination of the psychological criteria of this irrelevancy. The results of our experiments have, however, forced us to the opposite point of view. They show that, if imagery is present as part of the contents of thought, it is *ipso facto* relevant to the thought. This conclusion we reached only at the end of a series of experiments, in every one of which we had been 'set' to find irrelevant imagery in Koffka's sense.

We attacked the problem first on the side of relevancy, though always with the expectation of getting indirectly at irrelevancy. Our task was in part one of method, and the attempt to secure certain experimental conditions explains the sequence of the separate experiments which we undertook.

#### EXPERIMENT A. 1. PROBLEMS

Our aim here was to study the imaginal contents of thought with reference to its uses and relevancy to the thought. The method consisted of presenting to the *O* a simple problem to which he was asked to give an answer. After the answer had been given, he was asked to report the experiences upon which it was based. There were 83 problems or questions which may be roughly classified as follows:

##### 1. Arithmetic problems (9).<sup>5</sup>

<sup>4</sup> Cf. H. L. Hollingworth, The Vicarious Functioning of Irrelevant Imagery, *Jour. Philos. Psych. Sci. Meth.*, 8, 1911, 690.

<sup>5</sup> The numbers in parentheses refer to the number of problems of the various kinds.

Ex. At ten cents a yard, how much will eighteen feet of cloth cost?

2. Ingenuity problems (12).

(a) Easy (9).

Ex. A man wanted to catch a kitten, but the kitten ran up a tall tree which no person could climb. How could he get the kitten without hurting it?

(b) Difficult (3).

Ex. Out of 6 toothpicks make 4 equilateral triangles each one of whose sides shall be as long as a toothpick.

3. Abstract problems (3).

Ex. If the possession of money or wealth in any form should come to be regarded as dishonorable, what significant changes would result?

4. General Information problems (24).

Ex. Where is the painting, *Mona Lisa*?

5. Completion problems (4).

Ex. Supply the missing letters: F-r o-f-c-a- b-s-n-s- o-l-.

6. Enumeration problems (8).

Ex. If a box has 4 smaller boxes inside of it, and each one of the smaller boxes contains 4 little tiny boxes, how many boxes are there altogether, counting the big one?

7. Action problems (6).

Ex. Suppose that you stooped down to lift up a large bucket full of water, but that as you stooped down to lift it up it proved to be empty. What would happen?

8. Simple Judgment problems (5).

Ex. What is the thing to do if you go to sleep on the train, and do not wake up until you are several miles past the station where you wanted to get off?

9. Comparison problems (6).

Ex. If grey is darker than white, and black is darker than grey, what shade of those named in this sentence is lighter than grey?

10. Direction problems (3).

Ex. Suppose that you are going north, then you turn to your left, and then to your right. In what direction are you going now?

11. Imaginal problems (3).

Ex. Suppose that it is fourteen minutes before three o'clock. Now suppose that the two hands of the clock were to change places, so that the large hand takes the place of the small hand and the small hand takes the place of the large hand. What time would it then be?

We tried to include problems of various types, ranging from very simple questions, to which the answers were given immediately and automatically, to more difficult problems where complex processes of thought were involved. We hoped also to give opportunity for the use of different kinds of imagery, as visual (group 11), kinaesthetic (group 7), verbal-motor (group 1), etc; though we realized, of course, that the type of imagery used depends principally upon the imaginal type of the *O*.

At first the problems were typewritten and given to the *O*'s to read. With this procedure it was, however, impossible to control conditions, since the *O*'s tended to glance back over the problem, even though only one reading was formally allowed. This source of error prevented the taking of a time-record, which is sufficiently rough at best,

# RELEVANCY OF IMAGERY TO PROCESSES OF THOUGHT 199

since here the reading of the problem and its solution were inextricably combined. We then changed our procedure; *E* read the problem to *O* who was seated with his eyes closed and his back to *E*. When the last word of the problem had been read, *E* started the stop-watch, and stopped it when *O* gave his answer.

The instructions were: "I shall set you a simple problem. Your immediate task is to solve the problem. After you have reported your answer, I shall ask you to describe as well as you can the experiences upon which your answer was based." Later, to provide for a report in attributive terms, we changed to the following instructions: "I shall ask you a series of questions. Please give your answer as soon as it is ready. After you have answered, report so far as possible in attributive terms the experiences upon which the answer was based."

There were five *O*'s,<sup>6</sup> all of whom were graduate students or instructors in psychology; Miss A. H. Sullivan (*S*), and Messrs. H. Sheppard (*Sh*), M. J. Zigler (*Z*), H. S. Liddell (*L*), and L. B. Hoisington (*H*). Four of these *O*'s, *S*, *Sh*, *Z* and *L*, worked two periods a week; and one, *H*, worked one period. The observation-periods were usually one hour.

An analysis of the reports shows that imagery was used in a number of ways in the solution of the problems. A table indicating the different uses and the number of instances follows.

Uses		Number	
1. Anchor			
(a) Illustrative.....	136		
1. Memory experience.....	5		
(b) Non-illustrative.....	31		
(c) Combination of a and b.....	10	182	
2. Subject-matter of Problem			
(a) Changing.....	155		
(b) Fixed.....	57		
(c) Combination of a and b.....	9	221	
3. Regulation of Problem			
(a) Formulation.....	20		
(b) Anticipation.....	2		
(c) Criticism.....	17	39	
4. Means of Escape from Problem.....	5	5	
5. Illustration of the Answer.....	16		
(a) Reinforcement.....	5	21	

Total number of reports = 308.

In 21 instances the answer came as a sensorimotor response.

<sup>6</sup> Primarily the 'observers' in this study were 'subjects' who were performing a set task. We have named them 'observers' simply because our aim was to get them to describe the processes correlated with the meaningful stages in the performance of a task.

Illustrations of the different uses taken from the reports follow.

1. *Anchor. (a) Illustrative*

Problem 27. If the conductor on an Ithaca street-car rings up in one trip 41 fares, how much money has he taken in?

Report: "As the problem was read through, there was a scrappy visual image of something that meant 'conductor' (upper part of him) and of the tally machine at the other end of the car" (H).<sup>7</sup>

1. *Memory*

Problem 22. What would you do if a person who you know is crazy calls you ugly names?

Report: Visual image of a man sitting on a rock. It carries the meaning of the time when I was very small and one of our neighbors went crazy and my father struggled to keep him quiet" (Sh).

(b) *Non-illustrative*

Problem 56. If James had four times as much money as George, he would have sixteen dollars. How much money has George?

Report: "The two names were held by visual-verbal imagery. It meant the names 'James' and 'George' written in white on a black surface. These fluctuated in clearness. Occasionally both were present at the same time. They were spatially separated" (Z).

(c) *Combination of (a) and (b)*

Problem 64. What makes salt cake?

Report: "A visual image of a little pile of white salt. Verbal-motor repetition of problem: 'What makes salt cake?'" (Z).

2. *Subject-matter of problem. (a) Changing*

Problem 75. From what other method of transportation are the terms used on railroads taken?

Report: "Visual image of a blue-brownish mass. Meant 'boat.' Vanished quickly. Then a visual image of a coach going along a dusty road. In verbal-motor imagery the words: 'carriage,' 'coach,' 'pull-man'" (L).<sup>8</sup>

(b) *Fixed*

Problem 25. If the two diagonals of a square are drawn, how many triangle are thus formed?

Report: "Visual image of a square with the diagonals not completely filled in. The field is white and the lines black. I saw part of all four triangles" (L).

(c) *Combination of (a) and (b)*

Problem 67. Name three countries of Central America.

Report: "A visual image of a map of South America with its countries. Verbal-motor imagery of naming the countries (from the map) before I spoke them" (Sh).

<sup>7</sup> Cf. K. Bühler, Über Gedanken, *Arch. f. d. ges. Psych.*, 9, 1907, 353; H. J. Watt, Experimentelle Beiträge zu einer Theorie des Denkens, *ibid.*, 4, 1905, 361 ff.; and A. Messer, Experimentell-psychologische Untersuchungen über das Denken, *ibid.*, 8, 1906, 67 ff. The reports cited furnish instances of our 'anchoring' imagery.

<sup>8</sup> For illustrations of changing imagery cf. A. Messer, *op. cit.*, 57.

### 3. Regulation of problem. (a) Formulation

Problem 10. A boy was sent to the river to bring back exactly 7 pints of water. He had a 4 pint vessel and a 9 pint vessel. Show how he can measure out exactly 7 pints of water, using nothing but these two vessels and not guessing at the amount.

Report: "A visual image of two vessels, glass. One was half of the size of the other. One meant '4' and the other '9.' Then verbal-motor imagery meaning: 'You'll have to solve by interchanging in two vessels'" (Z).

#### (b) Anticipation

Problem 68. You say a flock of sheep, but a what of mackerel?

Report: "A visual image of sheep. Then I anticipated what was coming. This was carried by visual imagery of mother's flock of white leghorns and verbal-motor imagery in the naming of them" (Z).

#### (c) Criticism

Problem 17. What holiday comes nearest the middle of the year?

Report: "I thought of Christmas. This was carried by verbal-motor imagery" (L).

### 4. Means of Escape from the problem

Problem 70. What is a firkin?

Report: "I don't know. I thought of Oscar Firkins, a professor of English. This was carried by kinaesthetic and verbal-motor imagery" (S).

### 5. Illustration of the answer (coming after the answer)

Problem 47. Suppose that you are going upstairs in the dark and think that there is another step ahead of you. If there isn't, what happens?

Report: "Following the answer I had a visual image of the head of the stairs, and of a person there with his head down" (H).

#### (a) Reinforcement

Problem 6. Which is heavier, a pound of lead or a pound of feathers?

Report: "The problem was solved at the end of the reading. I had a visual image of the word 'Neither' and a period after it. The capital 'N' was typewritten. This came after the answer had been given" (L).

## Discussion of Results

The results show clearly that in the solution of problems and the answering of questions our O's had recourse to imagery. The most frequently occurring use is, as we might expect, that of imagery as the material for working the problem. Second in importance is the use of imagery as anchor. There were some instances (to be considered later) in which no imagery was used in the solution of the problems, but in nearly all of these cases the problem was anchored by imagery. It seems to be necessary to hold the meaning of the problem, or to fix its essential parts in some fashion, in order to answer it; and this is the use made of the anchoring imagery. The

attitudes included under "Regulation of problem" (3) probably occurred more frequently than they were reported. They are so largely meaningful that the underlying process easily escapes report. The meaning here is most often carried by verbal-motor imagery, though not infrequently other kinds of imagery do the work of formulation; and a visual image may correct a mistake or carry an anticipated meaning.

All of the imagery so far discussed is certainly relevant to the thought that it carries. We have, moreover, the statement of the *O*'s under the instruction to report "the experiences upon which the answer was based." Of a somewhat different nature are the five instances in which the imagery was used in aiding the *O* to evade the answering of the question. In three of the five instances reported the *O* was unable to answer the question, and so took refuge in imagery irrelevant to the problem-imagery. In the other two cases the answers were reached with difficulty, and the *O*'s allowed themselves to be side-tracked. We must note, however, that what we find here is not irrelevant imagery as such, but rather a shift to an attitude which is irrelevant to the problem-solving attitude. The imagery is relevant to the alternative attitude. The imagery which is illustrative of the answer (5) does not, of course, help in the solution of the problem. Its use seems to be the reassurance of the *O* that his answer is correct; and it carries in part the meaning of a feeling of satisfaction. In some instances it is purely associative. In any case the imagery is relevant to the attitude concerned.

There remain for consideration four phenomena reported by the *O*'s. These are:

	No. of cases
1. A felt need for imagery.....	6
2. Imagery as a hindrance.....	4
3. Irrelevant imagery .....	4
4. Cases in which the answer came immediately and automatically .....	20

We discuss these in the order above presented.

1. These instances show the dependence of the *O*'s upon imagery. The reports run as follows: *a*. "I was unable to get the hands of the clock changed in my visual image" (*L*). *b*. "I wanted to visualize and couldn't" (*S*). *c*. "This is difficult because I couldn't get a picture of the triangle" (*Sh*). *d*. "I tried to image the formation and couldn't, so that I used my fingers to help me out" (*L*). *e*. "I tried to visualize some paintings I had seen, and I couldn't" (*Z*). *f*. "I tried to get a visual image (to anchor the problem) and couldn't" (*S*). In 4 of the 6 instances (*c*, *d*, *e*, *f*) an incorrect answer or no answer at all was given. Of the 2 remaining cases, in *b* the *O* finally succeeded in evoking a kinaesthetic image which helped in solving the



problem; and in *a* the *O* reported that he could not be certain of his answer because of the incompleteness of the image which he had to use. These instances show that imagery not only is used when it is present, but also that its presence may be essential.

2. There were reported 4 instances in which imagery seemed to hinder rather than to help the *O*. Interestingly enough, though these include the reports of 3 different *O*'s, they are all of the same sort. The imagery which is reported as "being in the way" serves in every case as the anchor of the problem. Ordinarily, images serving this purpose drop out with the beginning of the solution of the problem, or become carriers of the processes involved in solving the problem. In 3 of the instances the anchoring images had the lure of familiarity, and were carriers of experiences more pleasing to the *O* than the duty of answering the question. This seems to be a form of "Means of escape from problem" (4). In the other case the *O* could not for a long time solve the problem, so that the anchoring imagery, which was very complete, was not replaced by any other imagery.

3. We have included under the heading "Irrelevant imagery" all imagery which was reported by the *O* as having nothing to do with the problem which he was solving. Since such reports bear directly on our main problem, we shall consider each one separately. *a*. Problem 6. Which is heavier, a pound of lead or a pound of feathers? Report: "A visual image of a flock of geese which some of my old neighbors used to have. There were several on a large pond and some on the bank. One spread out his wings and flapped them. This didn't help me solve the problem. The problem was solved at the end of the reading and this imagery came after the solution" (Z). The concluding statement of the *O* makes it clear that this is not a positive case of irrelevant imagery, but a case in which the imagery is relevant to a situation other than that involved in the solution of the problem. *b*. Problem 44. Can more than one meaning be attached to a sigh? If so, what meanings? Report: "As the phrase 'attach meaning' was completed, I thought of Titchener's 'Beginner's Psychology.' Then I thought of the next to the last lecture the first term. This was carried by visual imagery. . . . All of this bore no conscious relation to the answer given. The imagery came before the reading of the problem was finished" (L). It is evident that this imagery is used as an illustrative anchor which is anticipatory of the end of the problem. The last word of the problem, 'sigh,' demanded a shift in attitude so that the imagery reported is relevant to the attitude set up by 'meanings attached,' but not to the attitude which determines the answer. *c*. Problem 59. How would you criticize the following statement made by a judge to a prisoner: "You are to be hanged and I hope it will be a warning to you." Report: "A visual image of a young man, a round, ruddy lad. This is very clear. Other people are in the room. This is in the court-room of my home town. I think this is irrelevant [referring to the court-room]" (Z). We have here an example of imagery used as illustrative anchor. The irrelevancy, if there be any, is of the logical sort. *d*. Problem 6. Which is heavier, a pound of lead or a pound of feathers? Report: "The first thing that came to me was a remembrance of Prof. Angell, in his joking way, proving that psychologically feathers are heavier. This is not directly connected with the problem" (Sh). Again we find imagery used as an illustrative anchor, here in the form of a memory-image. It is difficult to see how this imagery is even logically irrelevant, since it obviously gives a clue to the answer.

4. A classification of the questions to which the answers came as sensorimotor responses throws light on the reason for this mode of response.

	No.
(a) Comparison problems .....	4
(b) Arithmetical problems .....	3
(c) Simple Judg. problems.....	3
(d) Gen. Informat. problems.....	6
(e) Easy Ingenuity problems.....	4

In the comparison problems the answer is dependent upon attention to the reading of the problem, for the answer is implicit in the statement. It may be necessary for some *O*'s to restate the question in order to answer it, but for others the auditory perception touches off the answer. The questions asked of the types *b*, *c*, *d*, and *e* are of so simple and habitual a sort that the answers, having been previously worked out, are "on the tip of the tongue." In other words, all of the 20 cases are instances of the presence of brain-habit.<sup>9</sup> As we have said above, we frequently find in cases of this kind some anchoring imagery, but none which is used as material out of which the problem is worked; such imagery is not needed.

### Conclusions

I. We have shown (1) that, in solving a problem or in answering a question, imagery may be used in no less than 5 different ways; and (2) that in all cases the imagery reported is relevant to the thought whose meaning it carries.

II. During the course of the experiment there became obvious many imperfections in the method, which we shall now briefly consider. (1) *Difficulty in selecting the problems or questions.* The selection of problems or questions is by no means a simple matter. At first the *O*'s were allowed to read the problems and to refer to them in the course of the solution. This procedure, however, did not permit of recording the time taken by the *O* to solve the problem or to answer the question. A time-record was deemed desirable as a check on the number of processes reported by the *O*, since he sometimes seemed to report experiences occurring, not in his solution of the problem, but during the period of introspection. We then tried reading the problem to the *O* and taking a time-record as described above. This proved to be a better procedure, but meant a change in the kind of problem used. A problem involving in its statement several terms or different steps, or a problem long in general, either could not be comprehended by the *O* or could not be held in mind from a single reading. Hence only those problems which could be simply and briefly stated and easily grasped could be used. Questions of general information were employed with the

<sup>9</sup> E. B. Titchener, *Thought-Processes*, 1909, 178 ff., 201.

hope of meeting this difficulty. It is not easy, nevertheless, to find questions which demand thought or present a real problem, and at the same time to avoid questions to which the answer comes automatically or to which the *O* can give no answer at all. There is, further, the task of selecting problems which shall not involve in their solution one type of imagery to the exclusion of others. The "clock" problems, the "folded and cut" paper problems, and the "box" problems are, for example, stated by Terman to test especially the ability to visualize.<sup>10</sup> The attempt was made to select problems appealing to other types of imagery as well. For example, we hoped that kinaesthetic imagery might be used in the solution of problems included in group 7. (2) *Difficulty in stating the problem.* We encountered a further difficulty in the statement of the problem. From the reports it was evident that the *O*'s were giving experiences set up by the descriptive part of the problem as well as those experiences upon which the answer was actually based. We were interested in the second form of report. To obviate this difficulty we tried to state the problems so that the important part for the answers should come at the end, as, for example: "What is a shoat?" (3) *Difficulty occasioned by the influence of the experimental attitude on the part of the O.* The *O*, having been informed in the instructions that he was to report the experiences upon which his answer was based, seemed in some cases to be disturbed by this requirement. This is shown by the fact (a) that some *O*'s "pondered" over questions which were simple, until there came to report something definite in the way of experiences which might underlie an answer reached almost immediately. For example, one *O* in his report on a "comparison" problem said: "The word 'oil' was articulated before spoken. I went through the problem in internal speech. The answer occurred immediately" (L). Yet the time recorded by the stop-watch was 14.4 sec. The tendency to wait for something "reportable" is perhaps the explanation of some of the illustrative imagery frequently reported. Some *O*'s delayed their answers until they were "ready to report," explaining the longer time thus required for the solution of the problem by remarks such as: "I was trying to think how I got the answer." Such a statement shows the honesty of the *O*, but makes the time-record valueless. The same thing is shown by the fact (b) that some *O*'s seemed to keep continually in mind during the solution

<sup>10</sup> L. M. Terman, *The Measurement of Intelligence*, 1916, 321, 328, 339.

of the problem that they were to report at the end, and accordingly introspected as they solved the problem. For example, one *O* said: "My introspections in this problem were separate from getting the problem. I have to answer the question and then go back to introspect" (*S*). Another illustration of the influence of the experimental attitude is the apparent fact (*c*)—*E* has no experimental proof except the time-records, which are otherwise difficult of interpretation—that in reporting the *O* sometimes added experiences then occurring to him, but experiences which were not a part of those upon which the answer was based. This, of course, is a trap into which it is easy to fall, and which can be avoided only by practice. It constitutes, nevertheless, one of the difficulties of the method, and involves the danger of assuming that the contents of the after-period are the same as those of the experimental consciousness. (4) *Difficulty in interpreting results.* The method puts the "burden of proof" upon *E*. His is the final interpretation of results. At best he can only check his interpretations by comparing the reports of different *O*'s and by repeating experiments. He is also aided by interpretations which the *O*'s sometimes "let slip."

That the method lacks the accuracy of other experimental methods is clear. Nevertheless, as a starting-point in an experimental investigation, it is valuable. "It will always be of service where new ground has to be broken, and where the formations are so complex that an immediate recourse to experiment in the strict sense is forbidden."<sup>11</sup>

#### EXPERIMENT A. 2. REPETITION OF FOX'S EXPERIMENT

With a view to further study of method and interpretation of results we undertook the repetition of an experiment reported by C. Fox in the *British Journal of Psychology*.<sup>12</sup> His problem and method bore some resemblances to ours in the experiment described above, and we hoped that a comparison of our results (from the repetition of the experiment) with his might throw additional light on both method and interpretation of results. We shall state briefly his procedure and the general results of his experiment and then give the conditions of our repetition of the experiment and our results.

Fox's subjects were told that "they were to investigate the existence and importance of thought without images, and to try to find out the content of such thinking."<sup>13</sup> They were also "to distinguish, as far as they could, between the thinking and the thought."<sup>14</sup> He worked with

<sup>11</sup> E. B. Titchener, *The Method of Examination*, *Am. Jour. Psych.*, 24, 1913, 429 ff.

<sup>12</sup> C. Fox, *The Conditions which Arouse Mental Images in Thought*, *Brit. Jour. Psych.*, 6, 1913-14, 420 ff.

<sup>13</sup> *Op. cit.*, 420.

<sup>14</sup> *Ibid.*, 420.

15 subjects, all of whom had had "previous practice in introspection."<sup>15</sup> The material used was 12 statements: 4 involving mathematical conceptions, 4 historical, 3 grammatical, and 1 a couple of lines from Milton. What the instructions were is not clear. We know only that "the subjects were told to record on a sheet of paper everything they could discover by introspection after each statement had been read twice by the experimenter. They were told to put down everything, however unimportant it appeared to them. . . . In fact all details, whether mental or physical, were to be noted. They were also told to put down first of all whether they realised the meaning of the statement read to them; and as soon as the meaning was realised the process of thought which had led to its realisation. If possible they were to state what the realisation consisted of; and whether it involved mental images or not. In cases where images did arise they were instructed to state whether the realisation of meaning preceded or succeeded the occurrence of the mental image."<sup>16</sup> Fox states later, however, that "these instructions were only fully carried out as regards that part of them which related to the realisation of meaning and to the occurrence of images."<sup>17</sup> The general results of the experiment he states as follows: "any delay or conflict in consciousness is a favorable condition for arousing a relevant mental image. . . . The experiments also show directly that the contrary set of conditions are (*sic*) unfavorable to the production of images."<sup>18</sup>

In repeating the experiment we used the same material, though the statements were read by *E* only once. Our instructions differed from those of Fox in the following respects. (1) We did not tell our *O*'s that they were "to investigate the existence and importance of thought without images."<sup>19</sup> (2) The reports were made orally by the *O*'s. (3) The instructions were less full and suggestive than those used by Fox, in accordance with his statement that his own detailed instructions "were only fully carried out as regards that part of them which related to the realisation of meaning and to the occurrence of images."<sup>20</sup> Since we were not certain whether Fox meant the same thing when he asked his subjects "to state what the realisation consisted of"<sup>21</sup> and when he told them to give "the process of thought which had led to its realisation," we used two sets of instructions which read as follows. (1) "I shall read you a statement. Please report whether you realise the meaning of the statement read and, if so, report the process of thought which led to its realisation." (2) "I shall read you a statement. Please report whether you realise the meaning of the statement read and, if so, of what the realisation consists." The 12 statements of Fox were used as material with the first set of instructions; but in order to make a comparable situation we were forced to use different statements for the second set of instructions. We endeavored, however, to find sentences equal in difficulty and similar, so far as possible, to those used by Fox; that is, 4 were mathematical, 4 were historical, etc. We had 5 *O*'s, 3 of whom, S, H, and Z, had acted as *O*'s in our first experiment. The

<sup>15</sup> *Ibid.*, 421.

<sup>16</sup> *Ibid.*, 421.

<sup>17</sup> *Ibid.*, 421.

<sup>18</sup> *Ibid.*, 430.

<sup>19</sup> *Ibid.*, 420.

<sup>20</sup> *Ibid.*, 421.

<sup>21</sup> *Ibid.*, 421.

other two, Messrs. F. L. Dimmick (D) and H. G. Bishop (B), were experienced *O*'s.

Following Fox, we shall present our results for each group of statements separately. As stated above, the first set of instructions was used with the original material of Fox. We had some difficulty in the use of these instructions. All of our *O*'s asked what we meant by "process of thought." They were told to interpret it as they liked; with the result that all took the instructions to mean that a report of both process and meaning was desired. We were also questioned about the meaning of the words "realise" and "realisation." One *O* (H) said: "To me 'realisation' is the concreteness of the situation; it is illustrative. I could say 'yes' as soon as you stop reading; but I have a determination to realise the meaning, and this has an inhibitory effect on the 'yes.'". Another *O* (Z) stated that "verification usually, but not always, seemed necessary;" while a third *O* (D) remarked: "I never am aware of the 'realisation.' It is nothing but what I talk about after I have finished. It is the attitude of accepting or rejecting the meaning." It is obvious that these three *O*'s will give different kinds of reports. We should expect the first, as was actually the case, to report more concrete imagery than the other two. Fox's subjects, for the most part, seem to have had no difficulties with the instructions.

We come now to a consideration of the reports on the propositions in the first group (mathematical statements). From the analysis of his subjects' introspection, Fox draws the following conclusions. 1. "In the first place it is perfectly clear that a considerable amount of thinking is entirely independent of mental images. Of the 60 thought-processes of the 15 different subjects, 24 or 40% occurred without mental imagery."<sup>22</sup> Of the 20 thought-processes of our 5 *O*'s, 2 or 10% occurred without report of mental imagery, but not without observable processes. Such processes were mainly kinaesthetic sensations of strain around the face and eyes, inhibition of breathing, etc. Our *O*'s tended to repeat in verbal-motor imagery the proposition after it had been read by the *E*. It seems strange that none of Fox's subjects should have reported a similar tendency. 2. "As the statements selected would involve mental images of a very simple and definite type, if they occurred, namely of simple geometrical figures; and as the frequent mention of images during the experiment would in itself act as a suggestion to arouse images which would otherwise not occur, it seems probable that under normal conditions of thinking images would not arise in more than 50% of the cases."<sup>23</sup> This is sheer speculation. In the first place one cannot foresee what kind of mental images such statements would arouse, whether simple and definite or otherwise; nor has one any right to assume that "mental images of simple geometrical figures" are necessarily easier to call up than images whose complexity is greater. The fact that the *meaning* is of simple, geometrical figures does not prove that the *images*, or carriers of the meaning, will be simple. In the second place Fox criticizes his own procedure when he says that the "frequent mention of images during the experiment would in itself act as a suggestion to arouse images which would otherwise not occur;" since it seems that one aim of an experiment of this sort must be to avoid setting up suggestions. Furthermore, it is

<sup>22</sup> *Ibid.*, 423.

<sup>23</sup> *Ibid.*, 423 ff.

as logical to assume that the statement to the subjects that "they were to investigate the existence and importance of thought without images" would be as effective in setting up an attitude to report thought without images as in arousing the opposite tendency. At any rate, it is difficult to see why the suggestion should be valued at exactly 10%. 3. "In some cases strong imagery interferes with the act of thinking."<sup>24</sup> We found no such cases, though we found cases in which inability of the *O*'s to get an image prevented the full realisation of the meaning. 4. "Images tend to appear if the realisation of the meaning is not at once clear, or if there is a delay or a struggle in consciousness."<sup>25</sup> Our results confirm this statement, though in the case of our *O*'s verbal-motor imagery, which carries the meaning of a debate, is more common than the visual imagery reported by Fox's subjects. "Where the meaning is easily grasped or where assent has been previously given there seems to be no tendency to embody the thought in an image."<sup>26</sup> Though such instances are rare with our *O*'s, the assent or the realisation of meaning is carried by kinaesthesia of some sort. 5. "Suspension of judgment and doubt, both of which may be regarded as instances of delay or struggle in consciousness, are conditions which facilitate the emergence of mental images."<sup>27</sup> As we have already said, such attitudes were for our *O*'s characterised on the processual side by verbal-motor imagery, other modes of imagery, and kinaesthetic and organic sensations, together with feelings of pleasantness and unpleasantness. Although Fox had instructed his subjects to note "muscular strain or tension,"<sup>28</sup> no mention is made of it in the quoted reports.

The introspective reports for the remaining 3 groups of statements confirm, on the whole, both Fox's results and our own as stated above. 1. He says, in discussing the propositions of the second group: "If a subject makes a deliberate attempt to concentrate his attention on the meaning of a statement he may succeed in suppressing images which would otherwise occur."<sup>29</sup> This remark seems beside the point; for the fact that no images are reported because of "attention on the meaning" does not prove that images were not present and were not carriers of the reported meaning. Furthermore, this is a particular set assumed by one *O*, and its assumption is not justified by the instructions. 2. "Emphasis or a pause which constitutes a break in the free flow of thinking is favorable to the production of imagery. . . . This condition, too, seems to fit in with the general idea of a conflict or struggle . . . ." <sup>30</sup> The introspective reports in question refer to a proposition of group 2 (historical). Fox says: "In reading this sentence a distinct pause was made after the words 'mechanical inventions.'"<sup>31</sup> An emphasis or a pause probably is favorable to the production of imagery; but this does not seem to be analogous to a conflict or struggle. On the other hand, it is quite possible for a pause to arouse a mental image which does not accord with the further meaning of the statement; in which case it certainly

<sup>24</sup> *Ibid.*, 424.

<sup>25</sup> *Ibid.*, 424.

<sup>26</sup> *Ibid.*, 424.

<sup>27</sup> *Ibid.*, 424.

<sup>28</sup> *Ibid.*, 421.

<sup>29</sup> *Ibid.*, 426.

<sup>30</sup> *Ibid.*, 427.

<sup>31</sup> *Ibid.*, 426.

would not be used as are the images which appear as the result of a conflict. For example, in reporting on this same sentence, one of our O's (H) said: "'Mechanical inventions' gave rise to auditory imagery meaning 'Edison' and visual imagery in greys of different brightness that meant 'transportation' or 'industrial activity.' I seemed to have settled the thing until the word 'England' came. With this the visual image dropped out. Then an auditory image of the word 'England' that meant to assure myself of what you said. Then followed a bit of visual imagery in greys that referred to conditions in England and meant the translation of the previous meaning from this country to England." 3. "A strong image may obstruct the attempt to understand."<sup>32</sup> Fox does not define 'strong,' so that we do not know whether he refers to clearness, or to details, or to stability and duration. His illustrations of "certain cases" in which the image obstructs understanding do not, however, seem conclusive. In any case they do not prove, as perhaps they are not intended to prove, that thought may be imageless. One of Fox's subjects reports: "When I tried to realise the significance of the statement it was twice obstructed; at first by the picture of my old history room at school, then by my history book open at the page on feudalism."<sup>33</sup> This seems to be an example of our anchoring imagery. It is true, of course, that attention to these images for themselves would involve a shift in attitude, and that they would thus prove an obstruction to realisation of meaning. 4. In considering the propositions of the third group, Fox states that "prompt and thorough understanding coincides with the absence of images."<sup>34</sup> This is evidenced by the reports of three subjects of whom Fox says: "Three subjects obtained what may be described as an associative image, namely an image not directly called up by the lines but evoked by association with their meaning. In these cases the image was that of a book on education in which a similar doctrine to that expressed in the lines was discussed. Now those who had these images must have realised the meaning before the images came, since such images depend on understanding the meaning."<sup>35</sup> Hence he concludes that these three subjects realised the meaning of the statement without the aid of images. We have not the introspective reports for reference, and it may be that these present evidence that the images were associative. From what Fox tells us, however, it does not seem necessarily true that "those who had these images must have realised the meaning before the images came, since such images depend on understanding the meaning." It seems quite possible that the image of "a book on education" might have carried the meaning of the lines instead of being dependent on them. In conclusion Fox states: "The experiments show that any delay or conflict in consciousness is a favorable condition for arousing a relevant mental image, that is, one that will in some way tend to help towards a cessation of the conflict. All the other conditions which we have found to be suitable for stimulating the production of mental images are reducible to this general formula. . . . The experiments also show directly that the contrary set of conditions are (*sic*) unfavorable to the production of images. Thorough or imme-

<sup>32</sup> *Ibid.*, 427.

<sup>33</sup> *Ibid.*, 427.

<sup>34</sup> *Ibid.*, 429.

<sup>35</sup> *Ibid.*, 429.



diate understanding, an easily grasped conception, ready assent to a proposition, straightforward or unimpeded reasoning, are all cases in which, as a general rule, images play no part. Further, concentration of thought on meaning is unfavorable to the stimulation of mental imagery, but this cannot be brought easily under the above general formula."<sup>36</sup> We agree with Fox's statement with respect to the conditions favorable for arousing mental imagery. We cannot, however, fully accept his statement of conditions unfavorable to the stimulation of imagery. "Thorough or immediate understanding," as in cases where the propositions come to the *O* labeled "You've accepted me before," may be explained by the operation of brain-habit, so that no imagery would be needed. In "straightforward or unimpeded reasoning" it seems probable that, the attention being on meaning, the processes might be overlooked. Of the 60 thought-processes of our 5 *O*'s, only 3 or 5% occurred without imagery. We are, accordingly, inclined to believe that, in some at least of the situations mentioned by Fox as unfavorable to the production of imagery, the imaginal content was overlooked, so quick is the process of thought and so completely is the attention of the subject likely to be concentrated on meaning. We have a parallel case in the neglect of after-images and double images in everyday experiences when other things are in the focus of attention. We should, therefore, agree with Fox's last statement (if we may change the word 'stimulation' to 'report') that "concentration of thought on meaning is unfavorable to the *report* of mental imagery."

The general results of the experiments in which we used the second set of instructions and material similar to the statements of Fox may be briefly mentioned. With the exception of one *O*, D, these instructions were interpreted as calling for a report both of meaning and of process. This *O* persisted in his statement that he was never "aware of the realisation" and so could not report on it. The reports with these instructions were much less full, and the use of the expression "of what the realisation consists" seemed to throw the emphasis on meaning rather than on process. One *O* (as we have reported above) said: "To me realisation means a sort of acceptance or approval of the meaning." If Fox's subjects interpreted his instructions in this way, it is evident that they were set to report meaning and not process; so that images, although present, may easily have been overlooked.

Two things may be learned from the repetition of this experiment: (1) the necessity of phrasing instructions carefully and accurately; (2) the need for as flexible and unbiased an interpretation of results as possible.

#### EXPERIMENT B. 1. LIKENESSES AND DIFFERENCES

Our problem remained the same as in Experiment A. In considering the results of this experiment we discussed some of the difficulties encountered in arranging material and determining procedure. In Experiment B we tried to overcome some of these difficulties. Our material consisted of paired words whose relations to each other with respect to likeness, difference, etc., the *O*'s were to give. It may be remembered

<sup>36</sup> *Ibid.*, 430 ff.

that we found that one of the sources of error in the material used in Experiment A was the lengthy statement of the problem. We hoped that the series of paired words would eliminate this difficulty; the question asked in the instructions would finally be present only as a set, and the statement of the problem would be reduced to two words. It seemed also that this type of material might be a halfway house between the "wordy" problem and the single word-stimulus.

The *O* was seated with his back to *E*, and was instructed to keep his eyes closed during the reading of the paired words and the determination of the answer. The instructions were as follows: "I shall present to you a series of paired words and I want you to tell me in what respect the members of each pair differ from each other. After you have done this, please describe as well as you can the experiences upon which your differentiation was based." Three series of 15 paired words each were used. The two words were read to the *O*; the stop-watch was started as the last word was spoken by *E* and stopped as soon as *O* gave his answer. The following are typical of the paired words used; cut-scratch, education-culture, possible-practicable, Dickens-Scott. There were five *O*'s. Two of these, *Z* and *H*, had worked in Experiment A. The others were Miss R. Stutsman (*St*), and Messrs. P. Cavanaugh (*C*) and E. Tolman (*T*). *C* had had some training in observation, but *St* and *T* were untrained. The experiment covered a period of two weeks. At the end of this time the *O*'s were asked to give likenesses instead of differences, and the instructions were changed accordingly. Thirty pairs of words, such as memory-imagination, water-air, nymph-mermaid, were used.

Uses	Number of Cases				
	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>
1. Anchor					
( <i>a</i> ) Illustrative.....	57	93	6	12	7
( <i>b</i> ) Non-illustrative.....	18	24		2	
( <i>c</i> ) Combination of <i>a</i> and <i>b</i> .....	12	8			1
2. Subject-matter of Problem					
( <i>a</i> ) Changing.....	42	90	12	16	12
( <i>b</i> ) Fixed.....	6	3		6	
( <i>c</i> ) Combination of <i>a</i> and <i>b</i> .....		1			
3. Regulation of Problem					
( <i>a</i> ) Formulation.....	9	8			2
( <i>b</i> ) Anticipation.....					
( <i>c</i> ) Criticism.....	2	3			
4. Means of Escape from Problem					
5. Illustration of the Answer.....	6	3			2
( <i>a</i> ) Reinforcement.....	3				

*a*, *b*, etc., at the head of the Table, refer to the relationships listed on p. 213.

The experiment covered a period of a week. In order to eliminate certain difficulties, which we shall discuss later, we again changed the material and instructions. We still used paired words, but words which stood in various relations to each other. The instructions were: "I shall read you 2 words. You are to tell in what respect (a) they are like each other, (b) they differ from each other, (c) one is dependent upon the other, (d) one is convertible into the other, (e) one affects the other. After you have given your answer, please describe the experiences upon which the answer was based." Before pronouncing the 2 words, *E* indicated the relation between them to be given by *O*. The following are typical of the paired words used in this series: hypothesis-law (convertible), democracy-education (affect), capital-labor (dependent). The experiment lasted 2 weeks and with one exception (*H*) the *O*'s were the same as before.

We give first a classification of the imagery used in determining the various relations between the paired words.

The types of imaginal experience upon which the differentiations were based are:

1. Two images which may be present (a) simultaneously, (b) successively, (c) successively with a recurrence of the first image. Number of instances=104.

Stimulus: egg-stone. Report: "One is breakable, the other breaks. There was a scrappy bit of visual imagery, vague. It carried the meaning of falling and breaking. Over against that was a kinaesthetic image in the throat. It carried the meaning of hard, something that wouldn't break" (*H*).

2. Two images may be present and the basis for differentiation be carried by the second. Number of instances=13.

Stimulus: stumble-fall. Report: "To fall is to go clear to the ground. A visual image of myself stumbling on a brick walk. I was leaning forward. There was a weak kinaesthetic image in my chest and shoulders and a motor image in my toe. Then the word 'fall' came. With this there came, in just a flash, a visual image of a man lying on the ground. Then the difference came; to fall is to go clear to the ground" (*Z*).

3. One or two images may be present, the differentiation being made in verbal-motor imagery. Number of instances=27.

Stimulus: cook-fry. Report: "You boil in water, but you fry in grease. I had a visual image of something frying in a skillet. With 'cook' there was a visual image of a pot. I was trying to get at something in the pan and pot to differentiate them. This was in verbal-motor imagery: 'You don't fry in water'" (*Z*).

4. There may be a visual schema, accompanied or unaccompanied by anchoring images. Number of instances=15.

Stimulus: radical-progressive. Report: "A radical person has less sense than a progressive person. A visual image in dark grey of the two words written out on a neutral grey background. 'Radical' was above 'progressive.' At that point there was no difference. Then 'radical' moved rapidly to the right. The right meant 'ahead of,' 'away from,' or 'his going too far ahead to be sensible.' All this touched the answer off" (*C*).

5. There may be two modalities carrying the meaning of the first stimulus-word, the differentiation being based on the absence of one of the modalities in the imagery carrying the meaning of the second stimulus-word. Number of instances=7.

Stimulus: fry-cook. Report: "The difference is auditory. With 'fry' I had a vague visual image which meant a frying pan with meat on a gas-plate. This was very scrappy, and was accompanied by a clearer auditory image of equal intensity. With 'cook' there was a vague visual image of a pot. I saw nothing cooking in it, though the meaning was there. The auditory image was lacking here, and this lack forced the first difference" (H).

6. There may be verbal-motor imagery accompanied by illustrative imagery. Number of instances=3.

Stimulus: powerless-weak. Report: "You may have a little power and be weak, but if you have no power you can't do anything. I was at sea for a while. Then I thought (verbal-motor imagery) 'They're absolutely synonymous, but she asked for a difference.' Then I thought of an engine, an automobile engine, powerless; then of an engine running very weakly (visual imagery) and then came in the concrete experience which was the basis of differentiation" (Z). There were reported 3 instances in which the differentiations were based on different feelings (pleasantness and unpleasantness) set up by the two stimulus words; two instances in which the differentiation was based on two different sensations; and two in which it was based on a difference between image and sensation.

The types of imaginal experiences upon which the likenesses were based are:

1. Two images may be present (a) simultaneously, (b) successively, the likeness being determined by the presence of one or more similar qualities in the two images, or by full similarity, or by eye-movement from the one image to the other; or the answer may be set off immediately.<sup>37</sup> Number of instances=42.

2. There may be two images, the first of which carries the meaning of a superordinate class. Number of instances=16.

Stimulus: purple-orange. Report: "Both are colors. After the stimulus 'purple' I had a visual image of a patch of dark purple. With 'orange' the verbal-motor image 'color' came. The purple image meant 'color,' so that when 'orange' came I could give 'color' at once" (Z).<sup>38</sup>

3. There may be a visual schema. Number of instances=3.

4. There may be anchoring imagery together with verbal-motor imagery. Number of instances=12.

5. Illustrative imagery may follow or accompany a response given immediately. Number of instances=9.

Stimulus: apple-ball. Report: "Both are round. As soon as *E* had said 'apple-ball,' 'round' came. After I had made my decision visual images of 'apple' and 'ball' came" (Z).

<sup>37</sup> Illustrations will be given only in cases in which the types of experience differ from those reported for the differentiations.

<sup>38</sup> Cf. the "übergeordneten Begriff" of A. Messer, *Experimentell-psychologische Untersuchungen über das Denken*, *Arch. f. d. ges. Psych.*, 8, 1906, 78.

The analysis of the experiences upon which the determinations of the other kinds of relations were based showed no new types of imaginal experiences.

### *Conclusions*

I. We have obtained in this experiment further evidence of the importance of imagery. Although we reduced our problems to lowest terms, imagery was needed. Almost as important as the imagery is the part played by the "set" produced by the instructions. It will doubtless have been observed in the giving of both likenesses and differences that the presence of two images carrying the meanings of the stimulus-words was not enough in itself to touch off the answer. The determination to report a difference or a likeness was the essential thing. This is especially noticeable in the case of the differentiations.

II. Our material and procedure in this experiment were arranged with a view to eliminating some of the difficulties found in Experiment A. (1) *Material*. The shortened statement of the problem avoided the setting up of imagery present in the reading of a longer problem, and focused the attention on the question itself. This is clearly advantageous. On the other hand, unless the stimulus-words are chosen with care, much less thought is required than in the case of the problems. The acquisition of a set for a superordinate concept, as was the case with the likenesses, made *O*'s task considerably easier. The simplicity or perhaps the uniformity of presentation of the material seemed to make possible a fixed kind of reaction to it. The generality of the instructions permitted superficial answers and, accordingly, less thought on the part of *O*. The demand for a more fundamental likeness or difference meant the suppression of the first answer that came and the search for a second; all of which would increase the task of report. (2) *The task of the experimenter*. In the interpretation of results *E*'s work was much easier with the use of this material. The reports of the *O*'s were briefer and seemed to be more accurate and complete. The *O*'s were often able to say with reference to a specific process: "It was this that carried the meaning of likeness," thus marking it off from the other processes reported. If the *O*'s are to be trusted, *E*'s burden is appreciably lightened. (3) *The influence of the experimental attitude upon the O's*. We have already mentioned the fact that *O*, knowing he has to report his experiences, may be set to think in imaginal terms to a greater extent than is usual with him. Indeed, one of our

*O*'s, after having given a full report of the imagery used in making a differentiation, said: "If I were asked on the street to give the difference between "old" and "obsolete," I think that the thing would go off in verbal terms." This remark led us to undertake our next experiment.

#### EXPERIMENT B. 2. EXPERIMENT UNDER NON-LABORATORY CONDITIONS

We wished to find to what extent imagery is present as a basis for answering questions when the questions are not a part of a laboratory exercise. In other words, we wanted to catch our *O*'s without the experimental attitude upon them, and without the knowledge that they would be asked to give "the experiences upon which the answer was based." Outside of observation-hours questions such as would arise naturally in the course of a conversation were asked casually. When the "*O*" had as casually answered, we asked him if there were any imagery present as the basis of his answer. We have 29 reports from 5 of our regular *O*'s, Z, H, B, D, and S; and 4 reports from persons having no training in psychology. These reports are, of course, necessarily incomplete; but with only 3 exceptions there was reported imagery of some kind upon which the answer was based. In 2 of the 3 exceptions kinaesthesia was reported; and in the case of the remaining exception the subject stated that the answer came automatically. We give an illustration of the procedure used. The "*E*" and the "*O*" were talking about Stout and his books. *O* was asked what Stout had written, and replied: "He wrote a couple of books that I know of and he stands for the theory of conation." *E* then asked: "Did you have any imagery when you answered my question?" The answer follows: "Yes. I had a visual image of the titles of the books and of their covers. I also saw printed, as if an excerpt from a book, the word 'conative.'" This group of experiments shows that imagery is of frequent occurrence in everyday thinking. The high percentage of cases in which imagery was reported is undoubtedly due to the fact that 5 of the 7 persons questioned were trained *O*'s. The demand for a report under these conditions implies a quick shift from a logical to a psychological attitude, of which only trained *O*'s are capable. It is clear, then, that a good deal of imagery is present in thinking, and that its presence is not solely the result of laboratory conditions.

#### EXPERIMENT C

Our experiments in thinking gave us no instances of irrelevant material. Though we had been attacking our problem on the side of relevancy, we had expected to get at irrelevancy indirectly. It seemed best now to concern ourselves directly with irrelevancy. We began this section of our experimental work with experiments at the perceptive level, resembling everyday experiences. Each one of the situations in these experiments included an irrelevant factor. We wished to obtain a description of consciousness at the instant when the irrelevant factor appeared in the situation.

There were 3 parts of the experiment. (1) We set the *O*'s simple tasks into each one of which an irrelevant factor was introduced. At the appearance of the irrelevancy we interrupted the *O* in his task, and asked him to describe his experiences at the moment of interruption. There were 4 tasks of this sort: (a) the sorting, according to 3 presented samples, of buttons drawn from a bag in which was one button unlike any of the samples; (b) the sorting, according to the arrangement of holes punched in them, of cards taken from a piled pack, one of which was different from all the others; (c) the arranging, in order of preference, of samples of cloth pasted on paper, among which there was an oblong of paper with no cloth on it; (d) the presentation, for brief study, of a picture about which were later asked questions one of which had nothing to do with the subject-matter of the picture. The instructions were: "Here are 3 buttons, and others of the same sort are mixed up in the bag. You are to put your hand in the bag and, taking out one at a time, arrange them in piles according to the samples shown. When I say 'Now,' you are to drop the task if it is still incomplete and describe your experiences at the moment of interruption." The first part of the instructions was changed to suit the nature of the task, but the latter part remained the same for all 4 tasks. The time was taken with a stop-watch chiefly in order to hold the *O* strictly to his task.

(2) The material for the second part of the experiment was a paragraph the latter part of which was entirely irrelevant to the beginning. The irrelevant part was begun on the last line of a sheet of paper so that the *O* was obliged to turn to the second sheet to continue his reading. This arrangement had the double advantage of preventing the reader from glancing ahead to the irrelevant part, and of letting *E* know when to interrupt. The instructions were: "I shall give you a paragraph which I want you to read carefully enough to give its contents after reading. When I say 'Now,' you are to drop the task if it is still incomplete, and describe your experiences at the moment of interruption." (3) The material for the third part of the experiment consisted of 4 paragraphs which contained such errors as: repetitions, omissions, misspellings, transpositions, and omission of punctuation. The instructions were: "I shall give you a short paragraph which you are to read carefully. After you have finished your reading, you are to give a summary of the paragraph." After the *O* had read and reported on all 4 of the paragraphs, he was asked if he had noted any errors of form, and if so to describe his experiences when he noted them. Only one of the foregoing experiments took place in any one observation-hour, and it either preceded or followed other experimental work. There were 5 *O*'s, 3 of whom, H, S, and Z, had observed in Experiments A and B; and 2 of whom, B and D, had observed only in the repetition of Fox's experiment.

### *Sorting Problems*

Three of the tasks (1 (a), (b), (c)) were of the same general nature, *i.e.*, sorting problems. The reports show the presence of 4 stages in the realisation of irrelevancy:

1. Perception (usually tactual), accompanied by immediate judgment of difference and supplemented by imagery;
2. Visual perception of difference;

## 3. Feeling component:

- |                         |   |
|-------------------------|---|
| (a) Astonishment        | } Analyzable into kinaesthetic sensations, affective processes, and imagery |
| (b) Surprise and wonder |   |
| (c) Indecision          |   |

## 4. Reaction:

- (a) Immediate (directed by determining tendency);  
 (b) Mediate (verbal-motor imagery).

We give a report of the experiences described in the performance of one of the tasks. "First a cutaneous perception which was different from the preceding one; the pressure was much heavier. There was a brief snatch of visual imagery which went with this cutaneous pressure sensation and carried the meaning of the type of button and the fact that it was different. I think I verbalised this as: 'I wonder what this is.' Added to this was the perception of the visual black [the odd button was black], and then without consciously intending to do anything, I threw it outside. The kinaesthetic process and the perception of throwing brought the meaning of rejection" (D). In the case of some of the other O's the feeling-part of the experience was more marked. It was always present, and seems to be characteristic of the appearance of the irrelevant component of the situation.

The sorting of cards, as an experience containing an irrelevancy, was a failure. The card which differed in the arrangement of its punched holes from the other cards was in no case perceived as different, the difference apparently being so slight as to be overlooked. The reports on this situation are, however, valuable; they show the difference between a situation containing an irrelevant factor and one containing only relevant factors. We find reports of stage 2, the visual perception of difference, and of stage 4, the reaction. In this perception there was no tactual element, for the 'feel,' in general, of all the cards was the same. The significant thing is the absence of the feeling-component. Of importance, also, is the fact that in all cases the reaction was immediate, never mediate.

*Reading Problem: Irrelevant Meanings*

In their reports on the second part of the experiment, in which the material was the single paragraph, all O's noted the "meaninglessness" of the irrelevant part. The absence of meaning was accompanied by feelings of strangeness, confusion, puzzlement, etc. The meaning of irrelevancy was carried by pressure sensations (staring at the page), muscular tension (an attempt to hold the meaning together), and verbal-



motor imagery, which usually expressed an attempt to force a relationship to the preceding part of the paragraph.

*Reading Problem: Typographical Errors*

In the third part of the experiment we set our *O*'s too difficult a task. They could not give a report of processes, even when they had noted errors, so long after the observation had taken place. The difficulty was further increased by the set for relevant meanings. It should be said, however, that we were aware of the difficulty of this task; we had wished to arrange an everyday situation, like the reading of a newspaper, in which the irrelevancies should be commonplace. One *O* noticed no errors and said reproachfully when asked to report: "I didn't notice any errors; I wasn't set for proof-reading" (*Z*). The 4 other *O*'s remembered and reported mistakes in the paragraphs, but 2 of them could give no report of process because they had not taken the attitude for report. The third *O*, *H*, reported that he ignored the errors as he read, "for he was reading for thought rather than for grammar." He mentioned, however, a tendency to read aright in auditory imagery the mistakes, and also some verbal-motor imagery carrying the meaning of errors. The fourth *O*, *B*, reported verbal-motor imagery carrying the meaning of annoyance at writing so carelessly done by *E*.

*Conclusions*

We have seen that a marked irrelevancy is characterized by feeling accompanying the inhibition set up; and that where the irrelevancy is less marked, it tends to be overlooked because of the set for relevant meanings.

EXPERIMENT D. 1. PICTURES

In Experiment C we began to study irrelevancy directly. We arranged situations containing irrelevancies on the perceptive level, and we secured an analysis of the situations from our *O*'s. From these analyses we found that when an irrelevancy appeared in a situation it was accompanied by "feelings." We wished now to find out whether such feelings might be the criteria of the entrance of irrelevant imagery into an imaginal situation. To this end we had to arrange a situation in which there should be some imagery irrelevant to it; as, for example, the black button was irrelevant to the other buttons in the bag. We wanted, with our

*O*'s set for imagery, to have a complex background of imagery upon which they could draw. To secure this we used 3 kinds of material and procedure.

1. We presented to *O* a series of 12 pictures, mainly narrative, brightly colored, and varying in size from 6 by 8 inches to 12 by 16 inches. The instructions were: "I shall show you a picture for a short period. Please observe it carefully. At the end of this period you will be allowed two minutes in which to write a description of the picture, giving its title." The *O*'s were seated in front of a grey screen upon which was mounted one of the pictures. The picture was at first covered by a curtain, which was raised just after the "ready" signal and let fall after an exposure of 15 seconds. This procedure took one observation-hour. At the beginning of the next observation-period we gave the *O* the following instructions: "I shall name to you one of the pictures that you learned last time. When you hear the name, I want you to recall the picture as vividly as possible. Three seconds after I have named the picture I shall read you a simple problem which you are to solve as quickly as possible. Say 'Yes' when you have solved it, and then begin to report as fully as you can the course of your experiences during the experiment." After each one of the pictures had been presented once for recall, they were presented again in a different order, and followed by different problems.

2. The material for the second part of the experiment was put in the form of a completion-test. We took from various books descriptive paragraphs having the following titles: "The Mountains of the Desert," "Rules of Hunting among the Greenlanders," "Daybreak" (poetry), "A Japanese Garden," "The Winter Dwellings of the Esquimaux," and "A Simple Chronoscope." Several words, including all parts of speech, were omitted from these paragraphs. The *O* was given the following instructions: "I shall give you a paragraph in which some of the words are missing. You are to fill in the blank spaces, each of which indicates an omitted word. You will be given a certain length of time in which to do this. At the end of this time I shall say 'Now' and read you a problem which you are to solve. After you have given your answer, report all of your experiences from the reading of the problem to the giving of the answer." No fixed period of time was allowed for filling in the words of the paragraph. The *O* was interrupted in his task when he was seen to be near the end of the paragraph.

3. The material for this part of the experiment consisted of 3 separate words. For the most part the words all referred to a single situation as crowd—touchdown—cheers; though there were a few cases in which the 3 words might set up different trains of thought, as for example turkey—star—electric. The instructions show the procedure. "I shall read you 3 words. Give yourself passively to any imagery that comes. After 15 seconds, I shall read you a problem which you are to solve and report on in the regular way." *O* was seated with his back to *E* and with his eyes closed. There were in the three parts of Experiment D 5 *O*'s, all of whom had served in the other experiments.

In the first part of the experiment we endeavored to supply the *O* with a background of imagery upon which should be

impinged a problem to be solved. We desired, of course, to know what happened to this imagery when the problem came. We shall refer to the imagery called up by the *O* in this part of the experiment as the picture-imagery, since it was determined by the previous presentation of pictures. An analysis of the reports of the 5 *O*'s shows that the picture-imagery may behave in at least 3 different ways.

(1) It may drop out at the beginning of the reading of the problem, either suddenly or gradually.

Report: "The first imagery (picture-imagery) came quite quickly, so that when I repeated the name of the picture, it was there almost immediately. In quality it was greyish and reddish. It lacked a background. Then began the reading of the problem, and there was with it rather good visual imagery of trees. Somewhere here the first imagery went out" (D).

(2) It may remain during the reading of the problem, in which case the problem is (*a*) not sensorily clear, (*b*) not cognitively clear, (*c*) neither sensorily nor cognitively clear, and the picture-imagery loses in clearness, detail, meaningfulness; or there is a fluctuation in clearness between the picture-imagery and the problem, in which both seem equally insistent in turn.

Report: "The auditory stimulus (name of picture) carried the meaning of familiarity and with this there was a visual image of the bird sitting on a post out in Oregon where I knew the bird. Then quickly came the image of the picture as seen. The image was intense and rich in detail. Then the problem came. It was a sensation without meaning. The association with the bird persisted; its song came in auditory imagery and a visual image that meant 'bird' persisted all the time that the words of the problem were coming. It was there until nearly the end of the reading. During the last part of the reading the attention was on the auditory sensation more than on the meaning. Then an auditory image that meant the whole problem repeated twice. By this time the 'bird' was pushed aside and the attention was on the problem. The meaning of the problem became clear cognitively" (H).

(3) It may remain or may recur during the reading of the problem and be illustrative of it.

Report: "The auditory sensation of 'The Line Up' (the name of the picture) brought a visual image that meant the picture. It was rich in color-meaning. At first the auditory sensations were very obscure, not cognised. At the third word there was touched off a determination to solve the problem, and the visual imagery dropped right out. With the word 'cloth' (word of the problem) there was a recurrence of a bit of the picture-imagery meaning the red shawl on the man's back. From there on there was a determination to listen to the problem" (H).

What happens to the picture-imagery is obvious. Where it is irrelevant, it drops out; where it can be used,—that is, where it becomes relevant,—it remains. It is true that it may not drop out all at once; but in that case it interferes with the grasping of the statement of the problem, as well as

being interfered with in its turn by the problem. There is a struggle between the two for the field of attention, and now the one and now the other is clear. There is, moreover, no awareness of irrelevancy so far as the picture-imagery is concerned. The irrelevant factor here is the auditory perception of the problem, and we find its appearance characterised in much the same way as was the appearance of the black button. For example, one *O* reports: "I couldn't shake the picture out of my mind (when the problem came). There was muscular tension and internal speech while I was trying to get my bearings. There was strain around the eyes, discomfort, and unpleasantness" (B). This is evidently our feeling-component of Experiment C; but here, as there, it is characteristic of a perception, not of an image. We have another kind of situation when the imagery remains or recurs during the reading of the problem. In this case the shift from the picture-imagery-awareness to the problem-awareness has been made. In two of the three reported instances of this sort the picture-imagery has entirely faded out, and recurs only to carry the meaning, in an illustrative fashion, of part of the problem. It is to be noted that only that part of the picture-imagery which is relevant to the problem-meaning recurs; the whole of the image does not come back. We have thus succeeded in giving our *O*'s a background of imagery, and they draw upon this where they can; for the rest, it disappears. In the third instance included under this heading, the picture-imagery remained during the reading of the problem. It began, however, to lose in detail, and now one part and then another of the visual image was clear. The problem was lacking in cognitive clearness. The first word of the problem to be comprehended was the word 'trees' which the *O* said "persisted" and was related to a tree in the visual image. What we have here is a reinforcement of the problem-meaning by a part of the picture-imagery. After this the picture-imagery dropped out and the problem became clear. There remain for consideration 3 cases in which the problem-imagery was superposed on the picture-imagery. These we shall discuss along with the results of the third part of the experiment.

#### EXPERIMENT D. 2. COMPLETION-TESTS

We expected in this part of the experiment, as in the preceding part, that the *O*'s might be "revelling in imagery" when the problem came; and we hoped that they might have recourse to imagery in their attempts to fill in the blanks

in the completion-test. We interrupted them just before the paragraph was completed, so that any imagery present should have been at its richest. An analysis of the reports shows the experiences of the *O*'s when the problem came and the effect of the previous task on the problem.

1. There may be a complete and immediate shift in attitude from the completion-test to the problem.

Report: "In the paragraph the first blank was a nuisance to me. I was tired of the test and in a sort of careless attitude so that when the problem came I was glad; and the test dropped out entirely" (*Z*).

2. There may be between the test-attitude and the problem-solving-attitude a state characterised by the *O*'s as "a period of cognitive blankness" or as "a chaotic consciousness."

Report: "Consciousness was chaos at first. There was a series of auditory sensations having no meanings" (*S*).

3. The test-attitude, carried by (*a*) visual imagery, (*b*) kinaesthetic imagery or kinaesthetic sensation, renders the problem sensorily unclear, cognitively unclear, or both.

Report: "Visual imagery (from the completion-test) was present when you started reading the problem. As the problem was read I turned sharply toward you, meaning that I was going to pay attention. The first part of the statement came merely as auditory sensation and without specific meaning, though with the meaning 'here is the problem.' There was a reference back to the paragraph carried in kinaesthetic sensation; a tendency to turn the head back. Then there was verbal-motor imagery of parts of the problem and some visual imagery" (*D*).

4. The imagery used in the completion-test may hang over or recur during the reading of the problem, in which case the problem is sensorily and cognitively unclear or is not heard. The results of this experiment show that the conditions set are not conducive to the "carrying-over" of imagery from one situation to another; the break between the two situations is too great. What we really have here is a study of shift in attitude. There remains for consideration one case in which the imagery used in the completion-test remained during the solution of the problem. This we shall discuss in connection with the results of the third part of the experiment.

Just as in the first part of the experiment the reading of the problem was characterised by a feeling-component, so was it here. The *O*'s were "annoyed," "irritated," "bothered," when the problem was read and the set task interrupted. We are again reminded of the experiments in perception.

#### EXPERIMENT D. 3. THREE-WORD IMAGERY

In the third part of the experiment the procedure was more successful so far as the setting up of a background of imagery is concerned. We have a total of 324 reports from the *O*'s. These show that the imagery set up by the 3 words (to be referred to as the 3-word imagery) may behave as follows:

1. The imagery may drop out before the problem comes, or with the reading of the first word. Number of instances=79.

Stimulus: bells—horses—fire. Report: "I was trying to hear the bells ring when the problem came. This was carried by strain in the ears. This dropped out at once and the problem was the only thing in mind" (B).

2. It may remain during the reading of the first few words of the problem; or during the whole of the reading of the problem, in which case the problem may be rendered sensorily or cognitively unclear. Number of instances=79.

Stimulus: elephant—man—sawdust. Report: "The 3-word imagery was good. When the problem began I did not attend, for I was engrossed with a visual image of the elephant and his trainer and the sawdust on the floor. Then I 'picked up' a memory after-image of the first part of the question and the visual image dropped out" (Z).

3. It may recur or it may fluctuate with (a) the reading of the problem or (b) the solution of the problem. Number of instances=46.

Stimulus: June—stars—perfume. Report: "The 3 words set up visual imagery and also some auditory and olfactory imagery. The problem at first was obscure. The imagery persisted clearer than the sensation. Then the imagery dropped out and the sensation became clear cognitively. The visual imagery came back very, very briefly. There was no connection of meaning between the visual imagery and the auditory sensation. Then the visual imagery dropped out, meaning that I could get no aid in the problem from the imagery" (H).

4. It may remain or recur (a) as a whole, (b) in part, (c) changed in form or meaning or both, to serve as all or part of the anchoring imagery of the problem. Number of instances=50.

Stimulus: red—fragrant—alive. Report: "'Red' and 'fragrant' called up a visual image of a red rose on a small bush. Then in verbal-motor imagery, 'alive, alive; that's alive.' This imagery remained until E set the second situation (Problem: A man wanted to catch a kitten but the kitten ran up a tall tree which no person could climb. How could he get the kitten without hurting it?). The reading of the problem was accompanied by a shift in imagery. The thorns on the tree became large and looked wicked, meaning 'No person can climb it.' They also meant a very large bush like a tree. The rose was still on top and the kitten was near the rose" (Z).

5. It may remain or recur (a) as a whole, (b) in part, (c) changed in form or in meaning or both, to serve as the material for solving the problem. Number of instances=31.

Stimulus: prison—stripes—chains. Report: "The 3-word imagery was quite good and was of a prisoner in stripes with ball and chains on his leg. Then came the problem (Problem: How do you play 'Snap the Whip?'). There was verbal-motor repetition of the problem which helped me to remember it. The visual imagery was modified and now included a lake and skaters. The prisoner stood still in the middle of the lake as if the place where he had been in the 3-word imagery was now the ice. The 'ball' became a man and the 'chain' a string of skaters. Then the string of skaters moved and the prisoner stood there" (D).

6. It may drop out as soon as the problem comes, but may recur after the answer to the problem has been given, in which case it may

be (a) illustrative of the problem, (b) non-illustrative of the problem. Number of instances=6.

Stimulus: cat—yarn—basket. Report: "The 3-word imagery came. Then the problem was read (Problem: Suppose that you have been sitting in one position for a long time and your foot goes to sleep. What is the thing to do?). I hardly know what happened in the solution. I had a visual image which meant my foot going to sleep. This was an irregular patch with bright zigzag lines. Then I said the answer and back came the 3-word imagery" (D).

7. It may serve as a background into which is projected a person or the *O* himself who solves the problem. The background may last throughout the problem-solving or drop out before the problem has been solved. Number of instances=12.

Stimulus: dew—garden—silence. Report: "A visual image of a nice flower garden in the early morning before sun-up. I was in it. When the question came that visual image was still there vividly and I was solving the problem, projected to that garden (Problem: Why is an octave so named?). I was in the garden thinking: 'octave, octagon' in verbal-motor imagery. Then came the verbal-motor 'eight' and I said, 'do, re, mi, fa,' and gave my answer. The 3-word imagery was there until the end, but I was the important part in it" (Z).

8. It may recur to serve as a means of escape from solving the problem. Number of instances=2.

Stimulus: doctor—lawyer—minister. Report: "The 3-word imagery was present sharply and the problem came and was carried partly by visual imagery which was in the lower right part of the field (Problem: If 3 oranges cost one fifth of a dollar, how much will 2 cost?). The rest of the problem was carried by verbal-motor imagery with here and there a visual tag, but the solution seemed to be in terms of verbal-motor imagery. The 3-word imagery recurred at least 3 or 4 times. It seemed to be impossible to solve the problem. Later I made a specific effort. Once I said: 'Report that you can't do it.' Then by forcing myself I got the answer. Near the end there was a recurrence of the 3-word imagery. It was very, very scrappy" (D).

9. It may persist either through part of the solution or until the end of the solution of the problem, in which case the problem-imagery is (a) in front of it, (b) at its left or right. Number of instances=10.

Stimulus: infant—manger—wise men. Report: "There was good 3-word imagery. It stayed, so that there was no break when the problem came (Problem: How was Achilles made invulnerable?). When 'Achilles' was mentioned he seemed to be at the left of the other image; larger and clearer. He was running. Then I started to give the answer" (S).

10. It may remain throughout the solution until the answer has been given, in which case the *O* (a) can give no report, or at least no certain report, of the experiences leading to the answer, (b) states that the answer came immediately or automatically. Number of instances=5.

Stimulus: chimes—snow—carols. Report: "The 3-word imagery was very good. Then came the reading of the problem and its meaning was carried in verbal-motor imagery (Problem: Where do corks for bottles come from?). The 3-word imagery was still there and almost as good in detail as before. There may have been a little

tag of visual imagery which carried part of the meaning for my answer; I am not sure. About here I found myself answering. I didn't know I was going to answer until I heard myself" (D).

We are already familiar with some of the foregoing headings, so that a detailed discussion of them will not be necessary. The cases in which the 3-word imagery dropped out before the problem came included those in which the words had not evoked any imagery at all, and those in which the imagery was poor in detail and in clearness. Frequently, too, the set to solve the problem caused a clean break when the problem came, although the 3-word imagery might have been good. The cases in which the 3-word imagery remains or recurs during the reading of the problem or its solution are illustrative of the conflict between the *Aufgabe* and the 3-word imagery. The determination to solve the problem may overcome the 3-word imagery before the solution is actually entered upon or, as in the other possibility mentioned, the alternation between the problem-imagery and the 3-word imagery may continue during the solution of the problem. We find, too, that there may be a recurrence of the 3-word imagery after the answer has been given, that is, after the determination to solve the problem has been satisfied and the *O* is free. These cases are evidences that we succeeded in giving our *O*'s a background of imagery. A suggestion as to why the 3-word imagery dropped out is found in the report of an *O* who said: "The visual imagery carrying the 3-word situation came back very briefly during the reading; then it dropped out, meaning that I could get no aid in the problem from the imagery" (H). This brings us to the cases in which the *O* did secure aid from the 3-word imagery. To just what extent the imagery was used in the anchoring and the solution of the problem the illustrations will have shown. That this is the economical mode of behavior for the 3-word imagery is obvious. The *O*'s had a background of imagery, and upon this they drew in their solving of the problems. Frequently, only that part of the 3-word imagery which was relevant remained, the irrelevant part being lost; a further proof of our thesis that irrelevant imagery does not exist. We furnished our *O*'s with imagery logically irrelevant to a situation in which they might need imagery. If no aid could be got from the 3-word imagery or, in other words, if it was totally irrelevant, it dropped out. If, however, it could be used, though only in part, it so far remained. The cases in which the imagery became changed to carry the meaning are of interest. They show again the tendency to economy and, as well, the importance of relevancy. The cases in which



the imagery serves as an escape from solving the problem are like those met with in Experiment A. The cases in which the 3-word imagery remains as a background during the solution of the problem are further illustrative of use pushed to its limit. The *O* has been revelling in a field of imagery from which he need not wholly withdraw; that is, the 3-word imagery remains relevant to the new situation.

Before we consider the cases included under the two last headings (9 and 10) it seems well to discuss the attitude of the *O*'s toward the instructions during the last part of Experiment D. The smallest number of observations made by any one *O* was 55, the largest number, 73. The same instructions were used throughout the experiment and the same kind of material. For the sake of convenience and somewhat as a matter of course, the material was divided into 4 groups; the first group containing 10; the second, 13; the third, 15; and the fourth, 35 three-word situations. So far as the *O*'s were concerned, the instructions underwent a process of specialization. That is to say, the reported behavior of the 3-word imagery at the beginning of the experiment is quite different from its behavior at the end. Let us, for purposes of discussion, divide our classification of the behavior of the 3-word imagery into 5 sections. The first section will include those cases in which the 3-word imagery dropped out either before or at the very beginning of the reading of the problem. The second section will include all cases in which the 3-word imagery hung over during either the reading or the solution of the problem, but in which it did not aid in the anchoring or the solution of the problem. In the third section will be placed the cases in which the 3-word imagery was used as material for anchoring or solving the problem; and in the fourth section, the special and relatively infrequent uses of the 3-word imagery listed under headings 6, 7, and 8 of our classification. There remain for the fifth section the cases in which the 3-word imagery was present throughout the entire solution of the problem. All 4 groups of the 3-word situations will be found in the first section. This is to be expected, since the adequacy of the 3-words for setting up imagery cannot be predetermined, and such a word-situation may occur in any one of the 4 groups. That the *O*'s were, as time went on, more exactly obeying the instructions to take a passive attitude is shown by the relatively small number of cases in group 4 in which the 3-word imagery dropped out before the reading of the problem. In the cases included in the second section it is clear that the 3-word imagery is of more importance than it had been before. The *O* does not succeed in getting rid of it when the problem comes. This is perhaps due to the assumption of a more passive attitude with respect to the 3-word imagery. Nevertheless, the state of affairs is not satisfactory to the *O*; for he is hindered in both his comprehension and solution of the problem by the 3-word imagery. Group 4 of the 3-word situations contains the smallest number of cases of this kind, and group 3 the next smallest. This means that as the experiment went on the *O* was making a better adaptation to the complicated situation. When we come to a consideration of the third section we see at once a change. The 3-word imagery does not drop out with the coming of the problem, nor does it remain to disturb the *O* in his solution of the problem. It is used. The *O* has succeeded in meeting the situation with a minimum of

annoyance to himself. Two *O*'s did not reach this stage until the fourth group of 3-word situations, and one *O* never reached it at all.

The cases included in the fourth section we have discussed above. They are all illustrative of the uses of the 3-word imagery and, for the most part, occur in groups 3 and 4. What has been happening has been a specialisation of the instructions which is correlated with a successful adjustment to the situation. The specialisation has been in favor of the 3-word imagery. Instead of being a factor to be eliminated, it becomes one of value in meeting the situation, that is, in solving the problem.

In the fifth section, which includes headings 9 and 10 of our classification, the specialisation is continued.

In stages 9 and 10 the 3-word imagery becomes so favored that it remains through the solution of the problem, either together with the problem-imagery or to the exclusion of the problem-imagery. There occurs a shift of relevancy from the problem-solving to the experiment as a whole. What the *O* does is to attend to both kinds of imagery, the 3-word and the problem. He is interested now, not so much in solving the problem, as in giving a good report; a report that shall describe both the 3-word and the problem imagery. This sort of reaction to the experiment is confined to 2 *O*'s, and occurs in the case of one of them altogether within group 4 of the 3-word situations and in the case of the other within groups 2, 3, and 4. The reports show that in these instances a fluctuation between the 3-word imagery and the problem-imagery takes place, and that in the fluctuation the 3-word imagery does not completely disappear, though it loses in clearness and sometimes disappears for good before the problem-imagery disappears and the problem has been solved. The 3 cases of superposition of the problem-imagery on the picture-imagery referred to in part 1 of Experiment D,<sup>39</sup> and the one case in which the imagery used in the completion-test remained during the solution of the problem noted in part 2 of the same experiment,<sup>40</sup> are similar to the cases described here. They were reported by the same *O*, a fact which is further evidence of a special interpretation of instructions and of a shift in relevancy from the problem solving to the experiment as a whole.

In the 5 cases (confined to the reports of 2 *O*'s) found in part 3 of Experiment D and included under the tenth heading of the classification of the behavior of the 3-word imagery, the 3-word imagery is altogether favored. The *O* can give no report of the processes leading to the solution of the problem. In some instances he states that there was some pro-

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<sup>39</sup> Cf. p. 222 above.

<sup>40</sup> Cf. p. 223 above.

cess present but that "none came into great clearness." The other *O* stated that the answer was given automatically. In this connection we would call attention to the fact that in none of the 5 cases did the *O*'s have any doubt as to the relevancy of the imagery present. In every case they were certain that the imagery belonged to the 3-word situation and not to the problem, though they could not report on the imagery used in solving the problem. If, as Dr. Koffka thinks, we do not know whether or not our imagery in a given case is relevant or irrelevant, the *O*'s might well have reported, since they were specifically asked to give such a report, the 3-word imagery as the carrier of the solution of the problem. But this is exactly what they did not do.

The results of this experiment (D) confirm the results of those preceding. We have shown that, when imagery is occupying the focus of attention, if a new situation bearing no relation to it is introduced, two things may happen; the imagery either drops out, or it remains and is used in the new situation. We have found also that there may occur a specialisation of instructions, which means a shift of relevancy from one attitude to another, but that in no case is there any irrelevant imagery reported.

#### GENERAL CONCLUSION

All of the experimental work has led us to one conclusion, that *there is no irrelevant imagery*. That at the outset we had expected to find it is clear from our experimental procedure. We hoped at first to get some evidences of it indirectly; and when we did not succeed we arranged situations in which there were irrelevant factors. The analysis of irrelevantancies on the perceptive level showed that they are principally characterised by a feeling-component. This feeling-component we found in later experiments, though it was never a characteristic of irrelevant imagery, but always of a total situation irrelevant to another situation, each of which situations had its own relevant imagery. When we finally succeeded, in Experiment D, in giving our *O*'s a background of imagery logically irrelevant to a situation later introduced, we still found no irrelevant imagery. In such a case, if the imagery could be used either as a whole or in part, it remained; otherwise it dropped out. We can, then, answer Dr. Koffka's criticism that "sensory contents may be irrelevant to the thought;"<sup>41</sup> for we have seen that, if imagery is present, it is relevant; and accordingly, if the author to whom he

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<sup>41</sup> Koffka, *op. cit.*, 219.

refers meant by analysis "nothing else than the exhibition of the sensory contents present at any given moment,"<sup>42</sup> she was right in assuming that these contents were relevant to the thought.

We have called attention to the fact that not only did all of the *O*'s use imagery but that they frequently expressed a felt need for it. We have also brought evidence that this dependence upon imagery is not the result of laboratory conditions.

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<sup>42</sup> *Ibid.*, 219.